

## More Genetics Problems

### Polygenic Traits

1. In mice, the gene **C** causes pigment to be produced, while the recessive gene **c** makes it impossible to produce pigment. Individuals without pigment are albino. Another gene, **B**, located on a different chromosome, causes a chemical reaction with the pigment and produces a black coat color. The recessive gene, **b**, causes an incomplete breakdown of the pigment, and a tan, or light-brown color is produced. The genes that produce black or tan coat color rely on the gene, **C**, which produces pigment, but are independent of it. Indicate the phenotypes of the parents and provide the genotypic and phenotypic ratios of the F<sub>1</sub> generation from the following crosses:

a)  $CCBB \times Ccbb$

c)  $CcBb \times ccbb$

b)  $ccBB \times CcBb$

d)  $CcBb \times CcBb$

2. The mating of a tan mouse and a black mouse produces many different offspring. The geneticist notices that one of the offspring is albino. Indicate the genotype of the tan parent. How would you determine the genotype of the black parent?
3. The gene **R** produces a rose comb in chickens. An independent gene, **P**, which is located on a different chromosome, produces a pea comb. The absence of the dominant rose comb gene and pea comb gene (**rrpp**) produces birds with single combs. However, when the rose and pea comb genes are present together, they interact to produce a walnut comb (**R\_P\_**). Indicate the phenotypes of the parents and give the genotypic and phenotypic ratios of the F<sub>1</sub> generation from the following crosses.

a)  $rrPP \times RRpp$

c)  $RrPP \times rrPP$

b)  $RrPp \times RRPP$

d)  $RrPp \times RrPp$

## Sex-Linked Traits

1. A recessive sex-linked gene (***h***) located on the X chromosome increases blood-clotting time. This causes the genetic disease, hemophilia.
  - a) Explain how a hemophilic offspring can be born to two normal parents.
  - b) Can any of the female offspring develop hemophilia?
  
2. A mutant sex-linked trait called “notched” (***N***) is deadly in *Drosophila* when homozygous in females. Males who have a single (***N***) allele will also die. The heterozygous condition (***Nn***) causes small notches on the wing. The normal condition in both males and females is represented by the allele ***n***.
  - a) Indicate the phenotypes of the F<sub>1</sub> generation from the following cross:  
$$X^nX^N \times X^nY$$
  - b) Explain why dead females are never found in the F<sub>1</sub> generation, no matter which parents are crossed.
  - c) Explain why the mating of female  $X^nX^N$  and a male  $X^NY$  is unlikely.
  
3. A sex-linked recessive gene (***c***) produces a red-green colour blindness in humans. A normal woman whose father was colour-blind marries a colour-blind man.
  - a) What genotypes are possible for the mother of the colour-blind man?
  - b) The man’s father was normal; what are his possible genotypes?
  - c) What are the chances that the first child from this marriage will be colour-blind and a boy?
  - d) Of the girls produced by these parents, what percentage is expected to be colour-blind?
  - e) Of all the *children* produced by these parents, what proportion can be expected to have normal vision?
  
4. Duchenne’s muscular dystrophy (***d***) is sex-linked and usually affects only boys. Victims of the disease become progressively weaker starting early in life.
  - a) What is the probability that a woman whose brother has Duchenne’s disease will be heterozygous for the disease?
  - b) What is the probability that the same woman will have an affected boy?
  - c) If your father’s brother had the disease (but not your father), what is the probability that you will receive the gene?